FIRE OCCURRENCE
IN MISSOULA COUNTY, MONTANA
(1960 - 1973)

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Submitted by

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Submitted to

NORTHERN FOREST FIRE LABORATORY
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OBJECTIVES OF THE STUDY

: Examine fire occurrence patterns for Missoula County, Montana, for the time period 1960-1978.

: Relate fire occurrence and fire size data to fuel hazard type classification mapping completed for Missoula County.

: Assign fire occurrence and risk statistics to the proposed hazard classes existing in Missoula County, Montana.

STATISTICS USED IN STUDY

FIRE OCCURRENCE	(reported fire starts/year)
FIRE OCCURRENCE DENSITY	(reported fire starts/million acres/year)
ACRES BURNED	(total acres burned/year)
ACRES BURNED DENSITY	(total acres burned/million acres/year)

Fire occurrence, as used in this report, for any level of stratification, is the total number of fire starts occurring within the study area as reported on either the U.S. Forest Service 5100-29 forms, or in the Montana State and Private Forestry archived fire report forms.

Fire occurrence density is fire occurrence normalized by the number of acres within a fuel hazard category, written in units of fires/million acres/year. Thus, the 1522 reported fire starts within the estimated 986035 acres of the study area, for the 19 year period investigated, would give a fire occurrence density of 81.2 fires/million acres/year. The value of this statistic is not fully apparent untill comparisons are made between selected attributes of the study area, such as statistical cause or proposed fuel hazard types.

During the 1973 fire season, fuel hazard type 2 had 11 reported fire starts, while fuel hazard type 3 had 12 reported starts for the same time period. These numbers suggest little discernible difference in the potential number of reported fires to expect between the two types.

This observation may be misleading since hazard type 2 has over twice the number of acres as hazard type 3 in the area considered. Put on a per acre, or fire occurrence density basis; during the 1973 fire season, 177 fires occurred in hazard type 2 for each million acres of the type, while 416 fires/million acres/year occurred on hazard type 3 for the same time period. Density figures impart a different feeling about these two hazard types than does examination of fire occurrence alone. Placed on this "equal footing" basis, more informative comparisons can be made between selected attributes within an area.

Fire occurrence densities were computed using the following formula from Bevins (1979):

$$D_{ij} = 1{,}000{,}000 \times F_{ij} / (A_{ij} \times Y), \text{ where}$$

D_{ij} = fires per million acres per year in class j of stratification i,

F_{ij} = total number of lightning fires in class j of stratification i during the study period,

A_{ij} = mean number of acres in class j of stratification i during the study period, and

Y = number of years in the study period.

Acres burned is considered the total of all reported fire size acreages from the two data bases within any level of stratification. Where no total number of acres burned was indicated on Class A, spot fire records, 0.07 acres was used for the purposes of this study. This would be an area approximately 55 feet square.

Acres burned density is the total number of acres burned normalized by the number of acres within the selected grouping. For example, the study area had 4850.2 acres burned over the 19 year time period examined. Given the total study area estimated at 986035 acres, the annual acres burned could be estimated at 258.9 acres burned/million acres/year.

Caution should be used when making any predictions with the acres burned density statistic. From the standard deviations in the density tables, it is apparent that a great deal of variation exists within the annual acres burned and acres burned density calculations. In using these statistics there is a seventy percent chance that a projection of acres burned for any one year in the future could be over or underestimated by a factor of two or three times. Expressing the acres burned density as mean percent of land area burned annually may be a more useful interpretation. This can be determined by:

$$P_{ij} = D_{ij} \times 10^{-4}$$

P_{ij} = percent of class j area of stratification i burned per annum,

D_{ij} = acres burned per million acres per year in class j of stratification i, or acres burned density.

STUDY METHODS

Willian C. Fischer ascribed five fuel hazard classification categories to land areas in Missoula County, Montana. Through photographic interpretation and ground observations, portions of over 30 U. S. Geological Survey 7½ minute maps were color coded to fuel hazard type for non-Forest Service lands occurring within the county. This study was designed to:

- determine a suitable method to estimate acreages of each fuel hazard classification type;
- locate appropriate fire records;
- key fire records as to their hazard type;
- produce suitable input of coded fire records for data processing;
- develop computer programs to stratify fire occurrence and fire size data by hazard type, year, and statistical cause;
- compute fire density statistics from fire data and hazard type acreage estimates.

Proposed Fuel Hazard Classes

Based upon work by Fahnestock in Colorado (1971), William C. Fischer developed the following vegetation characteristics to describe proposed fire hazard classes for Montana wildlands (1977).

HAZARD TYPE	VEGETATION (FUEL)
1	None/Varied -- this type includes areas that are highway and railroad right of way, industrial fields, flood plains, and residential areas adjacent to higher order hazard types
2	Grass, weeds, brush, 2 feet or less in height; dead wood in contact with the ground; open confier stands with 0 to 35 percent corwn coverage; also stands of aspen, cottonwood, willow; grassland, brush other than sage or Ceanothus. Where slash or ladder fuels also present, these stands become Class 3.
3	Medium-density conifer stands with 35 to 55 percent crown coverage and surface fuels of mainly herbage and litter and some patches of reproduction and deadwood. Where slash is also present, these stands become Class 4.
4	Dense conifer stands greater than 55 percent crown coverage with any surface fuel; also includes medium-density stands with Class 5 fuels or much deadwood from blowdown, insect mortality or logging residues.
5	Dense to moderately dense flammable vegetation 2 feet or greater in height, including Gambel oak (seasonally in fall), big sagebrush, conifer reproduction, abundant litter and/or herbaceous fuel; scattered conifer stands may also be present.

For the purposes of this study, another category was included (hazard type 9). Fires reported as occurring within the study area but not occurring within an area coded to hazard types 1-5, were put into this class. Thus any fire with no corresponding fuel hazard type is included in this class. No vegetative characteristics may be ascribed to hazard type 9 since this type was created to hold unclassified hazard type fires for computational and statistical purposes.

Acreage Estimation

Acreage of hazard classification types on 33 U.S. Geological Survey 7½ minute series maps was determined by the weight apportionment method. Mylar strips overlaid on the hazard type classification maps were cut and grouped by hazard type. These strips were weighed and relationships developed to determine acreages based upon weight. Weighed to the nearest 0.001 gram introduced a minimum of error, however the process of cutting mylar strips, determining average container weights, and computation of total map areas in terms of weight were more of a factor in limiting accuracy. It is advised to use these acre estimates as relative measures between hazard types and apply them as ground truth statistics only in general terms. "The weight-apportioning method was developed by the U.S. Soil Conservation Service and has been found to be both efficient and accurate, particularly when the total areas of classes are desired rather than the areas of individual units" (Naylor, 1956).

Three maps had no areas coded to hazard type and were excluded from the study. The following figures are based upon 30 U.S.G.S. 7½ minute series maps, coded to hazard type. Acreages by hazard type are presented in Table 1.

average area/map	51.356	sq mi
total area included for study	1540.680	sq mi
total area weight	1159.100	gm
weight total all hazard classes	250.290	gm
weight total unclassified areas	908.810	gm
percent study area coded to type	21.6	%
percent study area uncoded to type	78.4	%
total area estimate	986033	acres
total coded area estimate	212919	acres
total uncoded area estimate	773114	acres

TABLE 1

ESTIMATED ACRES BY HAZARD TYPE

BASED UPON PERCENT BY WEIGHT

PROPOSED HAZARD TYPE	MEASURED WEIGHT	PERCENT OF TOTAL CODED AREA	ESTIMATED RELATIVE ACRES
	(gm)	(%)	(ac)
1	48.63	19.4	41369
2	73.28	29.3	62339
3	35.95	13.6	28881
4	66.20	26.4	56316
5	28.23	11.3	24015

Fire Report Data

Fire report data were examined from two primary sources; U.S. Forest Service 5100-29 forms, and Montana State and Private Forestry archived fire report forms. The latter also included the Blackfoot Protection Agency reports. An appropriate coding system was developed and state fire reports coded for machine processing. Summarized information on fires in Missoula County, reported on U.S. Forest Service 5100-29 forms, had been collected by Pat Hartless and Michael Hartkorn. This information was cross-checked with printouts of Lolo National Forest fire occurrence data used in previous density studies and included in the data base. The care taken by the State Fire Coordinators Office in organizing historical report forms into a microfiche library, and the similarity between state report forms and 5100-29 forms, insured compatability of location, statistical cause, and fire size information between the two primary sources of data. The following information was recorded for each reported fire:

: year
: month
: day
: statistical fire cause
: fire size class
: acres burned
: township number and letter
: range number and letter
: section number

Range, township, section, and quarter section was used to locate each fire record on the appropriate fuel hazard map. The fuel hazard type and map number for each fire was added to the fire report records. These records were keypunched and put on ADP magnetic tape. Computer programs were written to access and stratify the data, resulting in the tables presented in the Appendix of this paper. These tables were used to compute density statistics.

STUDY RESULTS

Fire Occurrence Density

The highest occurrence densities were in hazard types 3 and 4, medium-density and dense conifer stands, (151.2) and (151.4) respectively. These were followed by type 2, grass, weeds, and brush, with (104.5) fires/MMac/year. Types 1 and 5 were lowest with (73.3) and (76.7). (81.2) was the average annual occurrence density for the whole study area, irrespective of hazard type.

Statistical cause affects fire density numbers. Irrespective of hazard type, lightning was the most prominent mechanism of fire start with (39.5). Smoking, camp fires, debris burning, and railroad activities are roughly the same at (11.8), a factor of three less than lightning. Within hazard types, lightning is a more prominent factor in the medium-density, and dense conifer stands than it is in hazard types 1 and 2. Railroads are a prominent cause of fire starts in these two groups. This is logical and obvious in the case of hazard type 1, which included a lot of railroad right of way.

Acres Burned Density

In both data sets, with class C fires included and excluded, hazard type 2 had the highest acres burned density with (1939.4) and (74.3) respectively. With class C fires excluded, medium-density and dense conifer stands had the next highest figures of

TABLE 2

MISSOULA COUNTY

FIRE DENSITY BY PROPOSED HAZARD TYPE CLASS

HAZARD TYPE	ESTIMATED ACRES	FIRE OCCURRENCE No/Yr	St Dv	OCCURRENCE DENSITY N/mmAc/Yr	St Dv	ACRES BURNED CLASS C INCL Ac /Yr	St Dv	ACRES BURNED DENSITY CLASS C INCL Ac/mmAc/Yr	St Dv	ACRES BURNED CLASS C EXCL Ac /Yr	St Dv	ACRES BURNED DENSITY CLASS C EXCL Ac/mmAc/Yr	St Dv
1	41369	3.3	2.2	73.3	50.3	9.1	28.3	220.4	683.9	1.6	2.0	39.7	48.1
2	62339	6.5	3.6	104.5	58.4	120.9	307.0	1939.4	4924.3	4.6	4.6	74.3	73.8
3	28881	4.4	2.7	151.2	91.8	2.3	4.7	73.5	161.6	1.8	2.5	60.6	86.9
4	56316	8.0	4.9	151.4	81.5	5.0	5.6	88.0	98.8	3.7	4.9	66.1	87.8
5	24015	1.8	1.5	76.7	60.9	2.7	8.5	111.5	354.8	0.8	1.8	34.7	73.0
9	773114	55.5	25.9	71.8	33.4	115.3	197.1	149.2	254.9	23.2	15.5	30.0	26.1
TOT	986033	80.1	35.3	81.2	35.8	255.3	410.7	258.9	416.5	35.8	25.8	36.3	26.1

(60.6) and (66.1), but were the lowest two types with class C fires included, at (73.5) and (88.0) Ac/MMac/year. It is interesting to note that hazard type 5 had a reasonably high acres burned density even though it has a low occurrence density. This seems to indicate that fires occur with less frequency in this type but spread to a reasonably large size, possibly due to rapid spread rates. Also, the acres burned density statistic is more reduced by excluding class C fires than types 3 and 4. The above is also true of type 1.

No clearly discernible patterns are apparent between statistical cause stratified by hazard type. An interesting relationship does occurr however, between lightning and human caused acres burned densities. With class C fires included, lightning fires account for 32 acres burned/MMac/year while an average of all human caused fires is 25. By excluding class C fires, lightning acres burned is reduced to 14 while all other causes average to only 4 acres burned/million acres/year.

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APPENDIX A

TABLE A I

FIRE OCCURRENCE DENSITY

HAZARD TYPE BY YEAR

	HAZARD TYPE						
YEAR	1	2	3	4	5	9	TOT
1960	24.2	48.1	69.2	0.0	41.6	55.6	50.7
1961	75.5	48.1	242.3	213.1	41.6	84.1	92.3
1962	96.7	112.3	34.6	71.0	41.6	51.7	57.8
1963	75.5	32.1	138.5	213.1	41.6	86.7	90.3
1964	75.5	96.2	138.5	124.3	124.9	66.0	75.0
1965	0.0	64.2	138.5	71.0	41.6	22.0	30.4
1966	169.2	128.3	207.7	195.3	41.6	81.5	97.3
1967	48.3	96.2	173.1	88.8	83.3	71.1	76.0
1968	75.5	128.3	138.5	71.0	0.0	37.5	48.7
1969	145.0	224.6	311.6	106.5	41.6	60.8	84.2
1970	24.2	144.4	69.2	195.3	41.6	56.9	69.0
1971	145.0	208.5	138.5	159.8	166.6	85.4	103.4
1972	24.2	112.3	138.5	142.1	166.6	89.2	100.4
1973	145.0	176.5	415.5	372.9	208.2	182.4	198.8
1974	48.3	96.2	138.5	177.6	83.3	88.0	93.3
1975	0.0	16.0	103.9	106.5	83.3	42.7	45.6
1976	75.5	48.1	69.2	230.8	0.0	66.0	73.0
1977	96.7	144.4	138.5	159.8	166.6	91.8	102.4
1978	48.3	64.2	69.2	177.6	41.6	45.3	54.8
$\bar{X}$	73.3	104.5	151.2	151.4	76.7	71.8	81.2
SD	50.3	58.4	91.8	81.5	60.9	33.4	35.8

HAZARD TYPE BY CAUSE

	HAZARD TYPE								
CAUSE	1	2	3	4	5	9	TOT	X	SD
LIGHTNING	12.7	23.6	43.7	72.9	30.7	47.6	45.5	39.5	19.5
EQUIPMENT USE	2.5	1.7	3.6	2.8	0.0	1.0	1.2	1.8	1.2
SMOKING	10.2	13.5	21.9	17.8	6.5	5.6	7.5	11.9	6.2
CAMPFIRE	6.4	11.8	20.0	17.8	11.0	7.6	8.8	11.9	5.2
DEBRIS BURNING	12.7	11.8	18.2	14.0	17.5	2.9	5.3	11.7	5.8
RAILROAD	17.8	21.1	25.5	9.3	0.0	2.2	5.1	11.6	9.9
INCENDIARY	0.0	1.7	1.8	2.8	0.0	0.9	1.0	1.2	1.0
CHILDREN	7.6	8.4	3.6	5.6	2.2	1.7	2.7	4.5	2.7
MISC.	10.2	11.0	12.8	8.4	8.8	2.5	4.1	8.3	3.7
X	8.9	11.6	16.8	16.8	8.5	8.0	9.0	11.3	5.9
SD	5.5	7.5	13.4	21.8	10.2	15.0	13.9		

TABLE A 2

ACRES BURNED DENSITY WITH C CLASS FIRE INCLUDED

HAZARD TYPE BY YEAR

	HAZARD TYPE						
YEAR	1	2	3	4	5	9	TOT
1960	60.4	29.5	4.8	0.0	54.1	31.5	30.6
1961	82.7	22.0	113.6	203.3	50.0	32.2	46.3
1962	10.6	40.3	2.4	14.0	2.9	9.6	11.5
1963	40.4	2.7	9.7	32.0	2.9	18.8	18.8
1964	5.8	53.9	9.7	9.2	8.7	26.5	25.5
1965	0.0	4.5	9.7	5.5	2.9	1.7	2.3
1966	12.6	36.1	14.5	44.9	13.3	28.4	28.4
1967	3.4	173.9	120.5	26.3	15.4	33.6	42.9
1968	23.4	4091.7	69.6	246.3	0.0	23.6	294.3
1969	18.9	1161.9	710.8	92.5	2.9	23.6	118.9
1970	145.0	246.1	5.9	120.4	4.2	32.1	54.0
1971	28.3	10801.4	7.6	228.7	60.8	621.3	1186.0
1972	65.7	161.1	24.6	61.4	21.2	963.4	773.1
1973	150.1	624.3	116.7	345.2	317.3	409.1	397.4
1974	3.4	6.7	24.6	38.4	5.8	254.2	203.0
1975	0.0	1.1	7.3	8.0	5.8	10.3	9.0
1976	533.9	3.4	106.3	29.1	0.0	98.3	104.5
1977	2999.1	19304.4	145.8	50.6	1546.5	52.7	1432.4
1978	3.4	83.6	4.8	116.5	2.9	163.0	140.1
$\bar{X}$	220.4	1939.4	73.5	88.0	111.5	149.2	258.9
SD	683.9	4924.3	161.6	98.8	354.8	254.9	416.5

HAZARD TYPE BY CAUSE

	HAZARD TYPE								
CAUSE	1	2	3	4	5	9	TOT	$\bar{X}$	SD
LIGHTNING	5.9	14.4	9.1	40.2	18.0	74.6	62.6	32.1	27.5
EQUIPMENT	0.2	0.9	4.7	1.1	0.0	0.6	0.7	1.2	1.6
SMOKING	0.9	9.0	24.6	4.3	4.7	7.4	7.5	8.3	7.7
CAMPFIRE	0.4	459.3	2.2	9.1	1.9	4.8	33.4	73.0	170.7
DEBRIS BURNING	38.5	3.0	5.8	16.3	83.1	21.1	21.5	27.0	27.3
RAILROAD	10.3	18.2	23.7	7.6	0.0	1.9	4.2	9.4	8.7
INCENDIARY	0.0	23.7	0.9	0.2	0.0	3.8	4.5	4.7	8.6
CHILDREN	159.2	182.2	7.4	2.3	2.2	0.7	19.2	53.3	80.7
MISC.	4.9	1228.4	0.9	6.8	1.6	34.2	105.1	197.4	456.2
$\bar{X}$	24.5	215.5	8.8	9.8	12.4	16.6	28.7		
SD	52.0	408.7	9.1	12.4	27.1	24.5	34.6		

TABLE A 3

ACRES BURNED DENSITY WITH CLASS C FIRE EXCLUDED

HAZARD TYPE BY YEAR

	HAZARD TYPE						
YEAR	1	2	3	4	5	9	TOT
1960	60.4	29.5	4.8	0.0	54.1	31.5	30.6
1961	82.7	22.0	113.6	25.7	50.0	32.2	36.2
1962	10.6	40.3	2.4	14.0	2.9	9.6	11.5
1963	40.4	2.7	9.7	32.0	2.9	18.8	18.8
1964	5.8	53.9	9.7	9.2	8.7	26.5	25.5
1965	0.0	4.5	9.7	5.5	2.9	1.7	2.3
1966	12.6	36.1	14.5	44.9	13.3	28.4	28.4
1967	3.4	173.9	120.5	26.3	15.4	33.6	42.9
1968	23.4	161.5	69.6	6.6	0.0	23.6	32.1
1969	18.9	87.1	354.2	92.5	2.9	23.6	40.5
1970	145.0	246.1	5.9	120.4	4.2	32.1	54.0
1971	28.3	69.8	7.6	228.7	60.8	56.1	64.4
1972	65.7	161.1	24.6	61.4	21.2	19.2	32.7
1973	150.1	175.2	116.7	345.2	317.3	93.5	121.6
1974	3.4	6.7	24.6	38.4	5.8	24.0	22.4
1975	0.0	1.1	7.3	8.0	5.8	10.3	9.0
1976	1.7	3.4	106.3	29.1	0.0	25.9	25.4
1977	98.4	54.9	145.8	50.6	89.1	52.7	58.2
1978	3.4	83.6	4.8	116.5	2.9	27.2	33.6
$\bar{X}$	39.7	74.3	60.6	66.1	34.7	30.0	36.3
SD	48.1	73.8	86.9	87.8	73.0	20.1	26.1

HAZARD TYPE BY CAUSE

	HAZARD TYPE								
CAUSE	1	2	3	4	5	9	TOT	$\bar{X}$	SD
LIGHTNING	5.9	14.4	9.0	18.2	18.0	16.4	15.7	13.9	4.7
EQUIPMENT	0.2	0.9	4.7	1.1	0.0	0.6	0.8	1.2	1.6
SMOKING	0.9	9.0	5.8	4.3	4.7	4.7	4.8	4.9	2.4
CAMPFIRE	0.4	8.5	2.2	9.1	1.9	1.7	2.5	3.8	3.5
DEBRIS BURNING	10.5	3.0	5.8	16.3	6.4	2.2	3.6	6.8	5.0
RAILROAD	10.3	18.6	23.7	7.6	0.0	1.9	4.2	9.5	8.8
INCENDIARY	0.0	0.1	0.9	0.2	0.0	0.4	0.3	0.3	0.3
CHILDREN	6.6	11.7	7.4	2.3	2.2	0.7	2.0	4.7	4.0
MISC.	4.9	8.4	0.9	6.8	1.6	1.5	2.4	3.8	2.9
$\bar{X}$	4.4	8.3	6.7	7.3	3.9	3.3	4.0		
SD	4.3	6.2	7.0	6.4	5.7	5.1	4.6		

TABLE A 4

FIRE OCCURRENCE, CAUSE BY YEAR

60	37.	1.	3.	2.	4.	0.	0.	0.	3.	50
61	67.	2.	7.	4.	2.	5.	1.	1.	2.	91
62	34.	0.	7.	3.	10.	0.	0.	1.	2.	57
63	65.	1.	6.	4.	5.	2.	0.	2.	4.	91
64	48.	0.	10.	8.	1.	1.	0.	2.	4.	74
65	15.	0.	1.	6.	6.	1.	0.	0.	1.	30
66	59.	0.	15.	9.	8.	1.	0.	3.	1.	96
67	39.	0.	13.	7.	2.	9.	0.	2.	3.	75
68	22.	3.	1.	8.	1.	8.	0.	2.	3.	48
69	16.	2.	15.	13.	8.	17.	6.	3.	3.	83
70	30.	0.	9.	8.	7.	8.	0.	2.	4.	68
71	34.	3.	11.	16.	6.	14.	0.	9.	9.	102
72	61.	2.	7.	13.	4.	4.	1.	2.	5.	99
73	124.	5.	8.	19.	8.	11.	5.	7.	9.	196
74	52.	0.	9.	11.	11.	2.	2.	1.	4.	92
75	26.	1.	6.	4.	2.	3.	0.	1.	2.	45
76	51.	1.	2.	10.	6.	1.	0.	1.	0.	72
77	54.	1.	7.	9.	4.	4.	1.	11.	10.	101
78	19.	1.	3.	11.	4.	5.	3.	0.	8.	54
TOT	853	23	140	165	99	96	19	50	77	1522

TABLE A 5

FIRE OCCURRENCE, MAX TYPE BY YEAR

	1	2	3	4	5	6	TOTAL
60	1.	3.	2.	0.	1.	43.	50
61	3.	3.	7.	12.	1.	65.	91
62	4.	7.	1.	4.	1.	40.	57
63	3.	2.	4.	12.	1.	67.	89
64	3.	6.	4.	7.	3.	51.	74
65	0.	4.	4.	4.	1.	17.	30
66	7.	8.	6.	11.	1.	63.	96
67	2.	6.	5.	5.	2.	55.	75
68	3.	8.	4.	4.	0.	29.	48
69	6.	14.	9.	6.	1.	47.	83
70	1.	9.	2.	11.	1.	44.	68
71	6.	13.	4.	9.	4.	66.	102
72	7.	7.	4.	8.	4.	69.	99
73	6.	11.	12.	21.	5.	141.	196
74	2.	6.	4.	10.	2.	68.	92
75	0.	1.	3.	6.	2.	33.	45
76	3.	3.	2.	13.	0.	51.	72
77	4.	9.	4.	9.	4.	71.	101
78	2.	4.	2.	10.	1.	35.	54
TOT	63	124	83	166	3[illegible]	1055	/1522
$\bar{X}$	3.3	6.5	4.4	8.0	1.8	55.5	80.1
SD	2.2	3.6	2.7	4.9	1.5	25.9	35.3

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TABLE A 6

FIRE OCCURRENCE, HAX TYPE BY CAUSE TOTAL

	1	2	3	4	5	9	TOTAL
1	10.	28.	24.	78.	14.	699.	[illegible]
2	2.	2.	2.	3.	0.	14.	[illegible]
[illegible]3	8.	16.	12.	19.	3.	82.	140
[illegible]4	5.	14.	11.	19.	5.	111.	165
[illegible]5	10.	14.	10.	15.	8.	42.	99
[illegible]6	14.	25.	14.	10.	0.	33.	96
[illegible] 7	0.	2.	1.	3.	0.	13.	19
[illegible] 8	6.	10.	2.	6.	1.	25.	50
[illegible]SC 9	8.	13.	7.	9.	4.	36.	77
[illegible]	63	124	83	162	35	1055	1522

TABLE A 7

ACRES BURN W/C + CAUSE BY YEAR

	LIGHT	EQUIP USE	SMOKING	CAMPFIRE	DEBRIS BURN	RAILROAD	INCEND/ARY	CHILDREN	MISC	TOTAL
60	10.70	.07	2.54	1.77	9.74	0.	0.	0.	3.34	[illegible]
61	37.85	1.07	2.95	.34	.14	.91	.07	2.00	.32	[illegible]
62	4.10	0.	.45	.21	5.95	0.	0.	.10	.32	[illegible]
63	14.90	.07	.88	.28	.35	1.57	0.	.17	.34	[illegible]
64	9.53	0.	12.48	.79	.07	.07	0.	1.87	.31	25.12
65	1.05	0.	.07	.58	.42	.10	0.	0.	.07	[illegible]
66	15.53	0.	5.45	1.34	1.52	.07	0.	1.97	1.75	[illegible]
67	14.22	0.	13.55	4.09	.14	7.73	0.	.14	2.44	[illegible]
68	29.54	.69	.07	5.00	.07	8.71	0.	.14	245.96	[illegible]
69	8.57	3.40	15.79	2.48	3.12	13.08	1.70	68.37	.77	[illegible]
70	13.17	0.	4.12	8.01	12.04	13.93	0.	.23	1.74	[illegible]
71	32.34	4.14	43.70	536.39	7.36	11.09	0.	135.82	398.55	[illegible]
72	744.77	.87	3.49	1.31	.71	1.58	.07	8.47	1.01	[illegible]
73	172.66	1.41	16.28	10.53	64.92	7.82	82.14	7.94	28.16	[illegible]
74	11.92	0.	.60	4.06	145.92	.14	.14	.20	37.14	[illegible]
75	5.33	.50	1.28	.28	1.07	.21	0.	.02	.14	8.83
76	24.02	1.00	6.07	45.56	26.21	.07	0.	.07	0.	103.00
77	20.95	1.00	9.78	.63	43.14	3.97	.07	131.58	1201.29	[illegible]
78	2.26	.07	.21	2.70	80.14	8.28	.21	0.	44.28	[illegible]
TOT	1173.41	14.21	148.37	626.35	403.03	79.33	84.40	359.04	[illegible]	

TABLE A 8

ACRES BURN W/C + MAX TYPE BY YEAR

	1 [illegible]	2 BLUE	3 [illegible]	4 ORANGE	5 GREEN	6 [illegible]	TOTAL
60	2.50	1.84	.14	0.	1.30	24.38	[illegible]
61	3.42	1.37	3.28	11.45	1.20	24.93	[illegible]
62	.44	2.51	.07	.79	.07	7.45	[illegible]
63	1.67	.17	.28	1.80	.07	14.57	[illegible]
64	.24	3.36	.28	.52	.21	20.51	[illegible]
65	0.	.28	.28	.31	.07	1.35	[illegible]
66	.52	2.25	.42	2.53	.32	21.99	[illegible]
67	.14	10.84	3.48	1.48	.37	26.01	[illegible]
68	.97	255.07	2.91	13.87	0.	18.26	[illegible]
69	.78	72.43	20.59	5.21	.07	18.26	[illegible]
70	6.00	15.34	.17	6.78	.10	24.85	[illegible]
71	1.17	673.35	.22	12.88	1.46	480.31	[illegible]
72	2.72	10.04	.71	3.46	.51	744.84	[illegible]
73	6.21	38.92	3.37	19.44	7.62	316.30	[illegible]
74	.14	.42	.71	2.16	.14	196.55	[illegible]
75	0.	.07	.21	.45	.14	7.96	[illegible]
76	22.07	.21	3.07	1.64	0.	76.01	[illegible]
77	124.07	1203.42	4.21	2.85	37.14	40.72	1412.41
78	.14	5.21	.14	6.56	.07	126.03	138.15
TOT	173.20	2297.10	43.58	94.18	50.86	2191.28	4850.2
$\bar{X}$	9.1	120.9	2.3	5.0	2.7	115.3	255.3
SD	28.3	307.0	4.7	5.6	8.5	197.1	410.7

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TABLE A 9

ACRES BURN W/C • HAX TYPE BY CAUSE TOTAL

1	4.66	17.04	4.98	43.01	8.20	1095.52	
2	.14	1.07	2.60	1.17	0.	9.31	
3	.72	10.63	13.50	4.65	2.14	108.73	
4	.33	544.07	1.23	9.76	.88	70.08	
5	30.28	3.53	3.16	17.49	37.90	310.67	
6	8.07	21.93	13.03	8.18	0.	28.12	
7	0.	28.07	.52	.21	0.	55.60	
8	125.17	215.84	4.07	2.44	1.00	10.57	
9	3.83	1454.92	.49	7.27	.74	502.68	

ACRES BURN #D/C. CAUSE BY YEAR

TABLE A 10

	LIGHT	EQUIP USE	SMOKING	CAMP FIRE	L. BRUSH BURN	RR. USE	ENGINE USAGE	INCENDIARY	MISC.	TOTAL
60	10.70	.07	2.34	1.77	9.74	0.	0.	0.	5.34	[illegible]
61	27.85	1.07	2.35	.34	.14	.91	.07	2.00	.32	[illegible]
62	4.10	0.	.45	.21	5.95	0.	0.	.10	.32	[illegible]
63	14.90	.07	.38	.28	.35	1.57	0.	.17	.34	[illegible]
64	9.53	0.	12.48	.79	.07	.07	0.	1.87	.31	[illegible]
65	1.05	0.	.07	.58	.42	.10	0.	.0.	.07	[illegible]
66	15.53	0.	5.35	1.34	1.52	.07	0.	1.97	1.75	[illegible]
67	14.22	0.	13.56	4.09	.14	7.73	0.	.14	2.44	[illegible]
68	16.04	.69	.07	5.00	.07	8.71	0.	.14	.96	[illegible]
69	8.57	3.40	5.49	2.48	3.12	13.08	1.70	1.37	.77	[illegible]
70	13.17	0.	4.12	8.01	12.04	13.93	0.	.23	1.74	53.24
71	32.34	4.14	3.60	2.39	7.36	11.09	0.	.82	1.75	63.49
72	14.77	.87	3.49	1.31	.71	1.58	.07	8.47	1.01	32.28
73	58.66	1.41	16.28	10.53	4.92	7.82	4.14	7.94	8.16	117.86
74	11.92	0.	.60	4.06	1.92	.14	.14	.20	3.14	22.12
75	5.33	.50	1.28	.28	1.07	.21	0.	.02	.14	8.53
76	13.02	1.00	6.07	.56	4.21	.07	0.	.07	0.	25.00
77	20.95	1.00	9.78	.63	8.14	3.97	.07	11.58	1.29	57.41
78	2.26	.07	.21	2.70	5.14	8.28	.21	0.	14.28	33.15
	344.91	14.29	87.97	41.35	61.03	19.53	6.40	37.04	[illegible]	680.5

(A10)

ACRES BURN W/C, MAX TYPE BY YEAR

TABLE A 11

	1	2	3	4	5	6	TOTAL
60	2.50	1.84	.14	0.	1.30	24.38	[illegible]
61	3.42	1.37	3.28	1.45	1.20	24.93	[illegible]
62	.44	2.51	.07	.79	.07	7.45	11.33
63	1.67	.17	.28	1.80	.07	14.57	[illegible]
64	.24	3.36	.28	.52	.21	20.51	25.12
65	0.	.28	.28	.31	.07	1.35	2.29
66	.52	2.25	.42	2.53	.32	21.99	[illegible]
67	.14	10.84	3.48	1.48	.37	26.01	42.32
68	.97	10.07	2.01	.37	0.	18.26	31.68
69	.78	5.43	10.23	5.21	.07	18.26	[illegible]
70	6.00	15.34	.17	6.78	.10	24.85	[illegible]
71	1.17	4.35	.22	12.88	1.46	43.41	[illegible]
72	2.72	10.04	.71	3.46	.51	14.84	[illegible]
73	6.21	10.92	3.37	19.44	7.62	72.30	119.86
74	.14	.42	.71	2.16	.14	18.55	[illegible]
75	0.	.07	.21	.45	.14	7.96	8.83
76	.07	.21	3.07	1.64	0.	20.01	[illegible]
77	4.07	3.42	4.21	2.85	2.14	40.72	[illegible]
78	.14	5.21	.14	6.56	.07	21.03	[illegible]
TOT	31.20	98.10	33.28	70.68	[illegible]	414.38	680.5
$\bar{X}$	1.6	4.6	1.8	3.7	0.8	23.2	35.8
SD	2.0	4.6	2.5	4.9	1.8	15.5	25.8

ACRES BURN WO/C, HAX TYPE BY CAUSE TOTAL

TABLE A 12

1	4.66	17.04	4.98	19.51	8.20	240.52	294.91
2	.14	1.07	2.60	1.17	0.	9.31	14.29
3	.72	10.63	3.20	4.65	2.14	68.63	89.97
4	.33	10.07	1.23	9.76	.88	25.08	47.35
5	8.28	3.53	3.16	17.49	2.90	31.67	67.03
6	8.07	21.93	13.03	8.18	0.	28.12	79.33
7	0.	.07	.52	.21	0.	5.60	6.40
8	5.17	13.84	4.07	2.44	1.00	10.57	37.09
9	3.83	9.92	.49	7.27	.74	21.88	44.13
TOT	31.20	88.10	33.28	70.68	15.86	414.38	680.5